

Payment will be made at Contract Unit Prices for the following:

<b>Pay Item</b>	<b>Pay Unit</b>
Cable Trench	Linear Foot
Concrete Foundation	Each
Conduit ____ Size	Linear Foot
Multiple Underground Cable ____ Size	Linear Foot
Underground Conductor ____ Size	Linear Foot
Feed Point	Each
Light Standard	Each
High Mast Lighting Assembly	Each
Light Standard Extension	Each
Street Lighting Luminaire	Each
Bridge Sign Lighting	Each
Overhead Sign Lighting	Each
Sodium Vapor Wall-Mounted Luminaire	Each
Sodium Vapor Underpass Ceiling-Mounted Luminaire	Each
Relocate Light Standard	Each
Remove Light Standard	Each
Remove Feed Point	Each
Revise Concrete Foundation	Each

## **SECTION 772 HIGHWAY TRAFFIC SIGNALS**

### **772.01 DESCRIPTION.**

This work consists of furnishing and installing flashing beacons and traffic signals.

### **772.02 MATERIALS.**

- A. **General.** All work and material shall meet the National Electric Code, the North Dakota State Electrical Board, the local utility company, and the ordinances established by the local municipality.

The word and phrase definitions shall be as defined in Section 1 "Definitions" of the National Electrical Manufacturer's Association (NEMA) Standard Publication No. TS 2 Traffic Control Assemblies with NTCIP Requirements.

All materials shall be new and shall meet Section 896.

- B. **Shop Drawings.** Required shop drawings shall be furnished to the Engineer for approval within 50 days after the date of Contract execution by the Department. The dimensions, type of material, and the functional characteristics of the equipment to be installed shall be provided with the shop drawings.

The Contractor shall be responsible for the accuracy of the shop drawings. The Engineer's review and approval does not relieve the Contractor of full responsibility for providing a quality product that meets specifications. The approved shop drawings will be used for materials acceptance in lieu of certification. The Contractor shall submit 8 sets of shop drawings on the following listed items for approval:

1. Conductors
2. Pull Box
3. Saw Slot Sealant
4. Feed Point Equipment including:
  - a. Safety switch and lightning protection device
  - b. Flasher
  - c. Time Clock
  - d. Cabinet
5. Traffic Signal Standards including all necessary calculations and drawings used in designing these poles.
6. Combination Standards including all necessary calculations and drawings used in designing these poles.
7. Traffic Signal Heads
8. Beacon Heads
9. Pedestrian Signal Heads
10. Pedestrian Push Button
11. Detector Cabinet
12. Traffic Signal Controller with all components including, when required:
  - a. Controller
  - b. Flashers
  - c. Conflict Monitor
  - d. Coordination Equipment
  - e. External Logic Unit
  - f. Solid State Load Switches
  - g. Detector Amplifier

- h. Lightning Protection Device
- i. Cabinet

13. Emergency Vehicle Pre-Emption Equipment

- C. **Certification.** The certifications specified in Section 801.02 shall be furnished for conduit.

The Contractor shall provide a certification that all components of the LED signal modules meet the Institute of Transportation Engineers Standards.

- D. **Warranties and Guarantees.** All manufacturer warranties and guarantees with respect to materials, parts, workmanship, or performance which the products covered by the proposal bear shall be secured and included with the shop drawing submittal.

- E. **Wiring Diagrams.** The Engineer shall be furnished 4 complete sets of traffic signal cabinet wiring diagrams showing in detail all circuits and parts at the time the cabinet and control equipment is delivered.

These wiring diagrams will be distributed to the traffic signal cabinet, City, and Planning and Design Divisions of the Department.

Wiring diagrams shall contain all the control equipment and their associated connecting cables and termination points. Each wire in each connecting cable on the wiring diagram shall be identified as to its function and terminal number. Each terminal on the wiring diagram shall list the cable designation and connector letter or number of the wire terminated at that point. In addition, the wiring diagram shall contain a diagram showing the location of all control equipment, terminals, etc., within the cabinet as well as intersection layout showing the location of vehicle signal faces, pedestrian signal indications, loop detectors, pedestrian push buttons, etc., all labeled as shown on the Plans.

The main cabinet wiring diagram shall also contain the logic (schematic) diagram of the following as required:

1. In and Out Flash Circuitry
2. Detector Paralleling Circuitry
3. Detector Time Delay Circuitry
4. Calling Detector Circuitry
5. Coordination Interface Circuitry
6. Not Adding Initial During Non-Automatic Circuitry
7. Actuated Permissive Yield Period Circuitry
8. All other logic diagrams contained in the external logic assembly unit
9. Emergency Vehicle Pre-Emption Circuitry and Interface Points

- F. **Service Manuals.** The Engineer shall be furnished 4 service and operating manuals for the traffic signal controller unit, emergency vehicle pre-emption controller, and the Engineer will distribute the manuals as stated in Section 772.02 E.

Each service manual shall include the following minimum information:

1. Detailed description of operation and instructions for initial set-up
  2. All schematics and wiring diagrams of the unit
  3. Recommended servicing and service hints
  4. Complete parts list
  5. Recommended spare parts list
- G. **Additional Equipment.** The Department and the local municipality may order additional signal equipment along with the Contractor's shipment for the Project. Equipment shall be billed to the Department or the local municipality at the Contractor's cost. The Department or local municipality will unload and store any extra equipment ordered. The Department and the local municipality shall be notified by letter informing them of the impending equipment order. The Department or the local municipality will indicate the quantity of equipment desired in the Proposal. The quantity of equipment to be ordered by the Department or municipality will be limited to 10% of the total amount of the item, or items, to be supplied under the Contract.
- H. **Concrete Foundation.** Concrete used in the work item shall be Class AE Portland Cement Concrete mixed and proportioned as specified in Section 802. Grout shall meet Section 806.01.

### 772.03 CONSTRUCTION REQUIREMENTS.

- A. **General.** Various phases of the work such as foundations, conduit, conductor, standards, feed points, and controllers shall be completed as the materials become available. Signal installations at individual intersections shall be put into service as materials become available, and the system shall not be kept inoperative for the lack of a few parts.
- B. **Concrete Foundations.** Concrete Foundations shall meet Section 770.03 C.
- C. **Rigid Conduit.** Rigid Conduit shall meet Section 770.03 D.
- D. **Conductors.**
1. **General.** General requirements shall meet Section 770.03 E.1.
  2. **Traffic Signal Control Circuits.**
    - a. The traffic signal control circuits shall be in the location and have the number of conductors as shown in the Contract.
    - b. No. 16 AWG, 2-conductor cable shall be installed from each pedestrian push button to the controller. The cable shall be unspliced.

- c. Control cables running from the terminal block in each traffic signal standard base to each traffic signal head shall be installed. No. 12 AWG, 3-conductor cable shall be installed for each 2-section pedestrian head and No. 12 AWG, 5-and 7-conductor cable shall be installed for each 3-and 5-section vehicular head.
- d. Terminal blocks shall be provided for connections of control circuits in signal standard bases.
- e. Traffic signal control circuits shall not be spliced.

**3. Loop and Loop Lead-in Conductor.**

- a. The loop conductor shall not be spliced.
- b. The lead-in conductor shall not be spliced except at the pull box where this conductor and the loop conductor are spliced.
- c. The installation and splicing methods shall be as recommended under installation of loop detectors, Section 772.03 F.
- d. Microloop Probe set shall consist of furnishing and installing the micro-loop probes at the locations shown in the plans.
- e. Preformed Loop Detector shall be securely tied down to prevent the loop from floating during placing of concrete. The pull box end or the conduit shall be sealed to protect against water entrenchment.

**4. Additional Cable Quantities.** Additional cable quantities shall be installed to provide for slack and the wiring of controllers, feed points, and signal heads as follows:

- a. Nine feet at the controller
- b. Fifteen feet at post-mounted and pedestal-mounted vehicular signal heads
- c. Twelve feet at post-mounted and pedestal-mounted pedestrian signal heads
- d. Eight feet at each pedestrian push button
- e. Fifteen feet at each flashing beacon sign support
- f. Twenty-three feet at each signal pole with mast arm plus the length of the mast arm
- g. Ten feet at the feed point
- h. Five feet at each foundation for each incoming and outgoing pedestrian and signal head control circuit
- i. Six feet at pull boxes where connections are made

- j. Three feet at each foundation for each incoming and outgoing circuit which passes through the foundation with no connection being made.

E. **Pull Box.** Pull Boxes shall meet Section 770.03 F. The top surface of the pull box shall be flush with surfaced areas and approximately one inch above earth or sodded areas. The down side of pull boxes installed on inslopes shall not extend more than 4 inches above the ground.

F. **Installation of Loop Detectors.**

1. **General.** Interruption of the normal flow of traffic shall be the minimum time necessary for installation of the road loop. Work shall not begin until all material, equipment, and personnel are at the site. Barricades, warning signs, and flagpersons shall be placed to protect the workers and the traveling public.
2. **Layout.** The loop location shall be marked on the pavement. The loop shall be placed in the lane for which it was intended, perpendicular to the lane, and to the size shown in the Contract. The Engineer may move the loop location longitudinally to avoid joints, pavement cracks, manholes, and other obstructions. Care shall be taken when moving “presence” and “calling” loop locations so it is not possible for vehicles to stop between loops and go undetected. All loops in a “presence” or “calling” group may require adjustment.
3. **Pull Box Entry.** Conduit shall be installed from the pull box to the gutter or roadway edge as specified. Each loop shall have a separate conduit installed for the pull box entry. The excavation from the saw slot at the gutter or roadway edge shall be made by means of a punch or drill type tool, rather than by usual excavating methods. The visible portion of the gutter shall not be cut for conduit installation. The conduit shall be installed to directly receives the loop wire in line and not at an angle. The hole to receive the conduit shall be at a depth below the roadway surface so there is a minimum of 2 inches of cover on top of the conduit when installed. The top 2 inches of the cover over the conduit hole shall be of the same sealant used to close the saw cut. The conduit and the pull box shall be installed at the same time.
4. **Saw Cut.** The pavement slot shall be sawed with a self-propelled power saw equipped with a depth gauge and alignment guide. The pavement slot shall be cut cleanly and well defined. The saw cut shall be overlapped at all corners and right angle corners shall be cored as shown on the Standard Drawings.

The saw cut may be made at any time before installation of the wire. Slots shall be cleaned immediately after the cutting operation. Wooden strips shall be placed in the cut or a durable cover placed to prevent slot shrinkage or damage before the wire is installed.

5. **Cleaning of Saw Cut.** Before installing the wire, the saw cuts shall be checked for the presence of jagged edges or protrusions, and uneven, jagged edges shall be cut to a smooth line. There should be no cutting dust, dirt, oil, moisture, or other contaminants in the saw cut. Uneven, jagged edges shall be cut to a smooth line.

The sawed slot shall be clean and dry before the wire is installed.

Slots shall be flushed clean by a water stream and dried by an air stream. The blown air from the compressors shall be free of oil and water.

6. **Wire Installation.** Wire shall be installed without damaging the wire or the insulation. Damaged wire shall be replaced at the Contractor's expense.

Wire loops shall be installed without kinks or curls or stretched insulation. All loops shall be wound in the same direction. The beginning and end of the loop in the pull box shall be identified. A constant connection scheme for the color-coded, shielded loop lead-in wire shall be maintained throughout the intersection.

The loop wires from the beginning of the conduit to the pull box shall be twisted a minimum of 5 turns per foot. A minimum of 6 feet of slack for loop wire pairs shall be coiled and left in the pull box.

The wire shall be installed as low in the slot as possible, using a blunt-pointed tool if needed. A sharp-pointed tool shall not be used. The wire shall be held in place with short strips of polyethylene foam sealant backing placed over the wire at approximately every 2 feet. These strips shall be left in place while the sealant is poured. If the wire crosses a crack or joint in the pavement, the conduit shall be installed as shown.

7. **Testing.** Before pouring the sealer, the loop shall be checked for continuity, inductance, and insulation resistance. The test shall be made in the Engineer's presence, and the necessary equipment needed to perform these tests shall be furnished by the Contractor. The Department reserves the right to retest, and these test results shall govern the acceptance or rejection of the loop installation. Tests shall be made as follows:

- a. **Continuity Test.** Each loop detector circuit shall be tested for continuity at 2 locations:
  - (1) Loop detector at the pull box before splicing with the loop detector lead-in cable shall have a value less than 0.5 ohms.
  - (2) Loop detector and lead-in cable system at the traffic signal controller cabinet or detector cabinet after splicing in the pull box shall have a value less than 5 ohms. The continuity test ohm reading at the traffic signal controller cabinet or detector cabinet shall be greater than the ohm reading measured at the loop detector at the pull box.
- b. **Inductance Test.** Each loop detector and lead-in cable system shall have an inductance test measured at the traffic signal controller cabinet or detector cabinet. The inductance shall be in the range of 50 to 500 microhenries.
- c. **Insulation Resistance Test.** An insulation resistance test at 500 volts direct current shall be made at the traffic signal controller cabinet or at the detector cabinet between one loop detector lead-in conductor and the cabinet ground rod. The insulation resistance shall have a value of 100 megaohms or greater.

8. **Saw Cut Seal.** The sealer shall be used according to the manufacturer's instructions.

The sealer shall be poured into the slot to 1/2 depth. When the loop slots are 1/2 filled, the material shall be checked for air bubbles or material pileup. The slots shall then be filled to roadway level. Excess sealant shall be removed.

In no case shall a trough or a mound be formed.

The sealer shall completely surround the wires, displace all air in the cut and completely fill the area except for that portion filled with wire hold-down material. Sufficient time for the sealer to harden shall be allowed (according to the manufacturer's instructions) before traffic is permitted to move over the area.

9. **Final Test.** All tests specified in Section 772.03 F.7 shall be repeated and recorded after installation of the saw cut seal.

All test results shall be recorded in a test report furnished to the Engineer for distribution as follows:

- a. Original to the Construction Division
- b. One copy in the controller cabinet
- c. One copy to the Planning Division
- d. One copy to the Design Division

The loop detector test report shall have the following:

Project Number, Intersection, City, Loop Detector Location, Dimensions (length and width), number of turns, continuity (in ohms) at loop and at cabinet, inductance (in microhenries), and insulation resistance (in megohms).

10. **Detector Feeder Cable Installation.** The loop lead-in conductor shall be installed unspliced from the pull box to the controller. The loop detector system shall be moisture-proof. The loop wire and loop lead-in shall have ends stripped back approximately 5/16 inch. The splice shall be made using insulated pressure type wire connectors. A single coat of adhesive 55-C (Bishop Manufacturing Corp.) or equivalent shall be brushed on. The coat shall cover 1/2 inch of the outer jacket, exposed inner jackets, wire connector, and 2 inches of loop wire insulation. The adhesive coating shall be allowed to dry at least 5 minutes. Each splice shall be wrapped with 3/4 inch "Bi-Seal" Type 3 self-bonding electrical tape or equivalent. A half lap shall start at the center of the splice. The wrapping shall proceed approximately 3/4 inch past the connection end, then back over the connector to 3/4 inch on the other end, and return to the center. The same procedure shall be followed as specified above, covering the previous layer of tape with 3/4 inch "Scotch" No. 88 All-Weather Electrical Tape or equivalent. Both splices shall be wrapped together with 3/4 inch "Scotch" No. 88 Tape or equivalent. The entire splice area shall be covered including adhesive coating applied above. The splice shall be completed by inserting a 4-inch piece of "Scotch" No. 88 Tape or equivalent into the "V" formed by the loop wire.



11. **Loop and Lead-In Conductor.** A wood lath or other nonmetallic material shall be used to hold up the loop and lead-in conductor in the pull box so that the conductor does not touch the bottom of the pull box. The splice area shall be held up at the top of the conductor holding device.

- G. **Feed Point.** All conduits, cabinets, padlocks, conductor, service entrance heads, meter sockets (if required), and ground rods shall be furnished by the Contractor.

All equipment mounted in a switch box of the size shown on the Plans shall be arranged, installed, and wired as required. The local utility company shall be contacted for specific locations of feed points. The utility company will furnish and install the required single phase voltage service connection and any required meter. The Contractor shall lock and/or seal any switch box as required by the utility company or local governmental agency.

The Contractor shall provide and bear all costs for the electrical service necessary to operate and maintain the traffic signal system until the project is accepted by the Engineer.

H. **Traffic Signal Standards and Combination Signal and Light Standards.**

1. A pedestrian push button and sign shall be provided and installed when shown on the Plans.
2. The base, pole, and mast arm shall be painted the color shown on the Plans conforming to Section 772.03 Q. The luminaire mast arm shall be galvanized.
3. All standards shall be plumbed with leveling nuts. The hand hole shall be located away from traffic and the mast arms shall be perpendicular to the roadway centerline.
4. The anchor bolts shall be installed and tightened as specified in Section 754.03 E.5.
5. A rigidly-mounted terminal block shall be provided in the base of each standard, except Type I, for the connection of control circuits. Luminaires shall be fused in the base.

- I. **Traffic Signal and Pedestrian Heads.** Adjustable traffic signal heads shall be mounted vertically. The signal mounting hardware and housing color shall be as specified on the Plans.

Pedestrian signals shall be mounted vertically and shall be mounted within 2 inches of the pole.

The traffic signal and pedestrian head shall be mounted on 1 1/2 inch standard pipe and fittings. The signal and head shall be attached to signal poles using brackets that have threaded pole plates or pole clamps that accept the 1 1/2 inch standard pipe. The pole plates shall be of the type that are held to the pole by means of banding material.

Pedestal-mounted traffic signals and pedestrian heads shall be mounted on a post top slip fitter that attaches rigidly to the signal pole.

Mast arm signal mounted heads shall be rigidly mounted using plumbizers.

All heads shall be effectively hooded with a material that allows the signal heads, when lighted, to be seen dimly by personnel testing the signals. The hoods shall remain in place until authorization is given to operate the signal. The Engineer will determine when the installation is to be put into operation. The heads shall be positioned to provide the best possible view for the traffic to be controlled.

**J. Flashing Beacons.**

1. **Beacon Head Lens.** The required lens size and color shall be as specified.
2. **Service Poles.** Wooden service poles and the feed point equipment shall be installed as specified.
3. **Mounting.** The beacon heads shall be mounted on span wire and/or sign supports (posts).
  - a. **Span Wire Mounting.** The span wire supporting the beacon head and control cable shall be installed to support the lowest point of the beacon head a minimum of 17 feet and a maximum of 19 feet above the roadway surface. A normal sag of not more than 5% of the total span is permitted. Noncorrosive, 2 inch metal hangers spaced not more than 18 inches apart, or cable wrap in one-foot wide sections 18 inches apart may be used to attach the control cable to the span wire. All overhead conductor shall have an 18 inch drip loop at the service pole.
  - b. **Post Mounting.** The beacon head and conduit shall be attached to a sign support.

**K. Pedestrian Push Button Post.** The steel post shall be of the specified size, dimension, and color. Paint shall meet Section 772.03 Q.

**L. Pedestrian Push Button.** Pedestrian push buttons shall be installed at the specified height above ground level.

**M. Traffic Signal Controller.** The controller cabinet and the direction of the door opening shall be positioned as specified. The signal, interconnect, detector, power, and other circuits shall be connected to the terminals as shown on the manufacturer's wiring diagram. The cabinet shall be mounted as shown on the plans. The Interface Standards Type 1 or Type 2 shall be as shown on the plans.

The cabinets set directly on concrete foundations shall be set on a sealant and sealed with caulking inside and outside of the concrete base.

The field leads shall be neatly dressed to provide orderly arrangement of wires in the cabinet. Field leads shall not be cut shorter than the furthest terminal for the same function in the cabinet. Power conductors, detector lead-in cable conductors, and ground drain wire conductors, etc. shall be properly terminated on the terminal facilities provided for them in the cabinet.

**N. Emergency Vehicle Pre-Emption.** The emergency vehicle pre-emption equipment shall be installed at the location shown on the Plans. Necessary circuits shall

be connected to the terminals as shown by the manufacturer's wiring diagrams. Time settings shall be determined by preliminary runs conducted by the local jurisdiction.

- O. **Interim Traffic Signals.** Interim traffic signals shall be installed as shown on the Plans. Signal head(s), service poles, span wires, controller, and all other materials and equipment shall be furnished as specified. Service poles of the length shown shall be installed when required.

New signal lamps shall be furnished and installed by the Contractor. All traffic signal lamps for use in 8-inch traffic signals shall be 67 watt. The 12 inch traffic signal head for the "Red" and the stenciled lenses shall use 150 watt lamps, and the remaining 12 inch traffic signal heads shall use 116 watt traffic signal lamps.

Span and stabilization wires, rigid steel conduit, control cable, service poles, and other material shall meet Section 896. The span wire for suspending the traffic control cable shall be attached to the support poles at a level to make the lowest part of any traffic signal not less than 17 feet nor more than 19 feet above the roadway surface. A normal sag of not more than 5% of the total span shall be permitted. Thimble eyebolts, nuts, and washers shall be used to fasten the traffic signal span and stabilization wire to the wood poles.

Noncorrosion metal hangers or cable wrap shall be used to fasten the control circuit to the span wire. The 2-inch diameter metal hangers shall be spaced not more than 18 inches apart. The cable wrap shall be installed in one-foot sections with a maximum of 18 inches between these sections. All overhead conductors shall have an 18 inch drip loop at the junction with a pole.

The controller shall be installed on a wood pole in a manner acceptable to the Engineer.

The Contractor shall furnish and install feed points as shown in the Contract. The power company will make the final service connections.

- P. **Remove Existing Equipment.** The work of removal of existing equipment shall be performed according to the general requirements and to the specific requirements as follows:

1. **General.** Before removing existing equipment, arrangements shall be made for the local utility company to disconnect the power source. When the meter is no longer needed, the local utility will remove it.

The Contractor shall disconnect all wiring to the equipment and completely remove the item from its foundation. The equipment shall be removed without damage and transported to the designated storage site. Any items damaged in removal, transporting, or storing shall be replaced at the Contractor's expense.

The existing foundations shall be removed to a depth of 2 feet below the ground line and the surface restored to match adjacent areas. Foundation removal shall be considered incidental to removal of equipment.

All equipment removed shall remain the property of the Department.

2. **Removal of Signal Heads.** The conductor to the signal heads shall be disconnected. If no new signal heads are to be installed, the disconnected circuits shall be disconnected at the controller terminal strip. The wires shall be taped together and piled in the bottom of the controller cabinet.
3. **Remove Flashing Beacon System.** The Contractor shall remove the feed point after the local utility removes the meter. Beacon heads, controller, and wiring shall be removed from the poles. The poles, span wires, supports, and signs shall also be removed for storage.
4. **Remove Interim Traffic Signals.** Feed point equipment shall be removed from the service pole. The conductor to the signal heads and controller shall be disconnected and removed, and all equipment on the service poles shall be removed. The service poles, span wire, and stabilization wire shall be removed and stored as directed.
5. **Remove Traffic Signal System.** The existing traffic control signal system including the signals, controllers, and feed point shall be removed and stored.  
  
Conductor shall be disconnected, and standard and controller removed. The controller, traffic signal heads, and mounting brackets shall be removed from the standards, and the signal heads shall be removed from the mounting brackets.  
  
The old traffic control cable and concrete foundations shall not be salvaged. These items shall be removed and disposed of at a location acceptable to the Engineer.
6. **Remove Traffic Signal Controller.** The controller cabinet and all controller equipment shall be removed for storage. The foundation shall be removed and the surface of the site restored.
7. **Remove Feed Point.** The switch box, meter trim, and conduit shall be removed for salvage. The local utility will remove the meter.

Q. **Painting.** All equipment installed shall be painted with 2 coats of exterior enamel paint meeting Federal Specification TT-E-489. The color will be specified on the Plans.

The base and lower 12 feet of light standards with attached pedestrian signal heads shall be painted. The signal portion of combination signal and light standards including base, shaft, and mast arm shall be painted.

Application requirements shall be as specified in Section 770.03 Q.2.

- R. **Repairs to Sidewalks and Roadways.** Repairs to sidewalks and roadways shall meet Section 770.03 R and Section 770.04 A.
- S. **Revise Concrete Foundation.** The item "Revise Concrete Foundations" shall require removing concrete from an existing foundation, installing conduit, and replacing the concrete, as specified.
- T. **Tests and Acceptance.** When the installation is complete and at the time designated by the Engineer, an operating test shall be conducted for approval. The Con-

tractor shall furnish instruments and personnel required for all tests, record all test results, and be present during all tests and inspections. Nighttime tests and inspections will be held when directed by the Engineer.

1. **Initial Inspection.** An initial functional inspection shall be made approximately 15 days after all signals under the Contract are operational, except when snow or ice conditions are present preventing observation of installed equipment, or when extreme cold conditions prevent proper observation of equipment operations and adjustments.
  - a. When the above conditions exist, the initial inspection will be delayed. The Engineer will determine when conditions have improved so the inspection can be scheduled.
  - b. During the time of delayed inspection, all signals in operation shall be maintained by the Contractor. When conditions permit initial inspection to be performed, the other inspections will be performed as specified.
2. **Final Inspection.** A final functional inspection will be made 30 or more days after the initial inspection. The final inspection shall not be made until all malfunctions noted on the initial inspection have been corrected. The traffic signals shall be in operation during this time. The Contractor shall maintain the signals during the period between the initial inspection and final functional inspection.
3. **Final Acceptance.** Final acceptance will not be made until the system has been operating for 14 consecutive days after the final inspection without interruption due to malfunctions attributable to defective equipment or improper workmanship.

U. Welding applications as specified in Section 105.06 D.

#### **772.04 METHOD OF MEASUREMENT.**

A. **Linear Foot.** These items will be measured by the Linear Foot as follows:

1. **Saw Slot.** Measurement will be made along the saw slot. Saw slot sealant and its installation is incidental to Saw Slot.
2. **Cable Trench.** Measurement will be made along the slope of the ground at the centerline of the trench.
3. **Conduit.** Measurement will be made for each size of conduit. Conduit will not be measured for payment under this item when it is installed in foundations, feed points, overhead and sign-mounted flashing beacons, interim flashing beacons, and traffic signals. The method used to install conduit (such as boring, jacking, or trenching) will not be measured but will be incidental to conduit.
4. **Underground Conductor.** Measurement will be the length of conductor installed including the additional quantities required in Section 772.03 D.4.
5. **Loop Lead-in Conductor and Conductor Cable.** Measurement will be the length of conduit in which the item is installed including additional quantities required in Section 772.03 D.4.

B. **Each.** These items will be measured by the number installed. Separate measurement will be made for each size or type if more than one size or type is installed. These items are as follows:

1. **Concrete Foundations.** Anchor bolts, reinforcing rods, conduit bends, ground rods, and installation and tightening as specified herein will be incidental to the item and will not be measured for payment.
2. **Pull Box.** Conduit for the loop detector item will not be measured and will be considered as incidental to the item.
3. **Feed Point.** The required conduit, cabinets, padlocks, conductors, service entrance heads, meter trim, and ground rods will be considered as incidental to this item.
4. **Signal Standard, Combination Mast Arm Signal, and Light Standard.** The item shall consist of the standard, light standard extension, base, mast arms, fused disconnect, shims or leveling nuts, terminal block, pedestrian push button, painting, and a sign when required.
5. **Flashing Beacon.** The complete unit shall include conduit, conductor, feed point equipment, signal head, span wire, stabilization wire, service poles, and all other items required.
6. **One-Way, 2-Section Pedestrian Signal.** This item shall include connection to internal wiring.
7. **Detector Cabinet.** This item shall include all internal wiring, detector amplifiers, and other equipment required.
8. **Controller.** This item, for Controller Type 1 or Controller Type 2, shall include the cabinet, internal wiring, and other necessary equipment.
9. **Interim Traffic Signals.** This item shall include conduit, conductor, feed point, signal heads, span wire, stabilization wire, service poles, and other necessary equipment.
10. **One-Way Number of Units in Section Head.** This item shall include connection to internal wiring.
11. **Signal Adapter.**
12. **Beacon Head.** This item shall include the push button and sign.
13. **Pedestrian Push Button Post.** This item shall include the push button and sign.
14. **Revise Concrete Foundation.** This item shall include removal, disposal, and replacement of concrete and installing conduit.
15. **Emergency Vehicle Pre-Emption Unit.** This item shall include controller interface, phase selector, optical detectors, detector coupling units, pre-emption indicator lights, optical detector cables, indicator light cables, mounting

and fixtures, and all other items required to complete the emergency pre-emption system in place and in operation.

16. **Microloop probe.** Microloop (single, double or triple) probes shall be measured by the number of single, double or triple probe sets installed. This item shall include the trench, drilling holes, sand, conduits, saw slot, length of conductor from pull box including additional quantities required in Section 772.03 D. 4, and testing loops.
17. **Preformed Loop Detector.** Preformed Loop Detectors will be measured as a unit. This item shall include the conduit and length of conductor including additional quantities required in Section 772.03 D.4.

C. **Remove Existing Equipment.** The following items of removed equipment will be measured by the number of each item removed including disconnecting power, closing wire entrances, removing and disposing of foundations, and transporting and storing equipment removed.

1. Remove Signal Heads
2. Remove Flashing Beacon System
3. Remove Interim Traffic Signals
4. Remove Traffic Signal System
5. Remove Traffic Signal Controller
6. Remove Feed Point

#### **772.05 BASIS OF PAYMENT.**

Quantities as provided above will be paid for at the Contract Unit Prices for the several pay items listed on the Plans and in the Proposal Form. This payment shall be full compensation for all labor, equipment, and materials necessary to complete the work.

Payment will be made at Contract Unit Prices for the following:

<b>Pay Item</b>	<b>Pay Unit</b>
Saw Slot	Linear Foot
Cable Trench	Linear Foot
Conduit ____ Size	Linear Foot
Underground Conductor	Linear Foot
Loop Lead-in Conductor and Conductor Cable	Linear Foot
Concrete Foundations	Each
Pull Box	Each
Feed Point	Each
Signal Standard, Combination Mast Arm Signal, and Light Standard	Each
Flashing Beacon	Each
One-Way, 2-Section Pedestrian Signal	Each
Detector Cabinet	Each
Controller	Each

Interim Traffic Signals	Each
One-Way Number of Units in Section Head	Each
Signal Adapter	Each
Beacon Head	Each
Pedestrian Push Button Post	Each
Revise Concrete Foundation	Each
Remove Signal Heads	Each
Remove Flashing Beacon System	Each
Remove Interim Traffic Signals	Each
Remove Traffic Signal System	Each
Remove Traffic Signal Controller	Each
Remove Feed Point	Each
Emergency Vehicle Pre-Emption Unit	Each
Microloop (Single) probe	Each
Microloop (Double) probe set	Each
Microloop (Triple) probe set	Each
Performed Loop Detector	Each
Controller Type 1	Each
Controller Type 2	Each



